

Tree Seedling Production Systems in Northern Mindanao, Philippines

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Abstract This paper examines seedling production systems for small-scale forestry in northern Mindanao, particularly the constraints and opportunities to sustain the operation of smallholder nurseries. Various types of nurseries were identified to examine issues and concerns operators face, and data collected through a survey of nursery operators, discussion with government and NGO personnel, and literature review. Many smallholders in northern Mindanao have been engaged in seedling production, for farm needs and sale in local markets. The interest of smallholder to sustain seedling production depends on market demand and incentives, which translates to financial benefit on sound nursery practices and of reliable access to profitable markets. Activities that will assist smallholder nurseries to achieve full potential have been identified as: available nursery technologies to produce high quality planting materials in sufficient quantity; building farmer groups to facilitate seedling production and enhance the scale of product marketing; building partnerships with various service providers and other stakeholders to address technical, institutional, marketing and policy issues that may hamper the operation of smallholder nurseries; access to markets and market information; and provision of incentives and policy support. Associated benefits from small-scale seedling production accrue to the government, wood processors and to the public in general.

Keywords Smallholder nurseries · Nursery technologies · Institution building · Partnership-building · Marketing · Incentives

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Introduction

Between 1934 and 1990, the Philippines lost 10.9 M ha of forest cover with an average annual loss of 194,000 ha (DENR 2003). This left the country with only 6.46 M ha of forests in 1988 (Pulhin et al. 2006). The forestry sector's contribution to the country's gross domestic product (GDP) dropped from 12.5% in 1970 to just 2.3% in 1988 (PCARRD 1994), and to only 1.3% in 1990 (ADB 1994). A leading timber exporter over 1965–1975, the Philippines became the world's eight largest timber importer (Dauvergne 1997; ITTO 1996). Timber imports are depleting the country's currency reserves by PhP 14 billion per year (Orejas 2002).

To undo these negative consequences of deforestation, international, national, local and private agencies have worked together, and invested in rehabilitation programs using various technical and institutional approaches—from government-driven watershed reforestation to small-scale forestry and multiple product-based agroforestry systems (Mangaoang 2002; Pulhin et al. 2006). This concerted effort resulted in a 12% increase in forest cover by 2003 (FMB and NAMRIA 2004). Out of the 7.2 M ha, 6.5 M ha are found in forestland while the remaining 0.65 M ha are within agricultural areas, arising largely from individual household efforts and particularly agroforestry and tree farms (Pulhin et al. 2006). Nonetheless, about 5.5 M ha of denuded land is still available and in need of immediate rehabilitation. Reforestation continues to be an overwhelming challenge. The more than 20 M Filipinos residing in the uplands (Sajise 1998; Mercado and Cadisch 2004) have emerged as the potential and effective force to do this. Many upland farmers have been engaged in small-scale forestry and agroforestry systems where trees are planted as part of their routine crop farming. Most of the planting materials used come from their own nurseries, either group or individually managed. In northern Mindanao, smallholder nurseries¹ are becoming a profitable farm enterprise and a viable alternative source of planting materials to private and public small-scale plantings and reforestation programs (Garrity and Mercado 1993; Koffa and Roshetko 1999). However, the potential of these nurseries is constrained by lack of technical, institutional and policy support (Koffa and Garrity 2001; Tolentino et al. 2003; Gregorio et al. 2007).

This paper examines the small-scale forestry seedling production system in northern Mindanao, with a focus on factors enhancing and constraining smallholders to sustain their operations, and the elements needed to create an enabling environment for nursery operation.

Research Method

Information was obtained by visits to government, communal and private smallholder and household nurseries in northern Mindanao, discussions with forestry experts and literature review. Nursery operators were interviewed using

¹ A distinction is made in this paper between private and smallholder nurseries. The former are considered to be larger, and to mainly produce seedlings for sale rather than on-farm use.

open-ended guide questions to identify the issues involved in managing nurseries. Discussions were held with officers of government agencies including the Department of Environment and Natural Resources (DENR, Region 10) and Department of Agriculture (DA), and non-government organizations (NGOs). Secondary data were also utilized, particularly country and regional reports of government agencies and reports from NGOs and research institutes, as well as reviewing grey literature on nursery operations in Mindanao.

The Nursery Sector in Northern Mindanao

Northern Mindanao (Philippine Region 10) is composed of five provinces, eight cities, 85 municipalities and 2,020 barangays. Cagayan de Oro City and Iligan City are considered highly urbanized. The region has a total aggregate area of 14,033 km², of which Bukidnon is the largest province (8293.8 km²) and Camiguin (229.8 km²) the smallest. More than 60% of the total land area (7461.9 km²) is classified as forestland, the remainder being agricultural land. The people in the region are predominantly agrarian, and farming, natural forests and marine resources provide support for the 3.98 M people (NSO 2007).

There have been a number of government and private-sector initiatives to promote tree planting, designed to rehabilitate the large expanses of barren and degraded forests previously under logging concessions, and to ensure resource supply for the growing wood industry. DENR 10 in particular manages tree plantations and various community-oriented small-scale forestry programs, including the Integrated Social Forestry (ISF) Program, Community Based Forest Management (CBFM), tree farms and agroforestry farms. Some local government units (LGUs) have passed provincial and municipal ordinances appropriating funds to support CBFM and reforestation projects in their own jurisdictions. Successful initiatives include those established by the Bukidnon Provincial Government for the Bukidnon Environment Small-Scale Treefarm project (BEST), and the Municipal Government of Quezon (also in Bukidnon Province) Buy-Back Tree program. Other government agencies—including the National Irrigation Administration (NIA) and National Power Corporation (NPC)—and universities also manage integrated watershed development projects in which reforestation is a component. Also, many NGOs assist forest rehabilitation and agroforestry in upland farming communities.

Types and Scale of Seedling Production Operations

Tree nurseries are established to propagate planting materials from seeds, wildlings and cuttings for planting on farms and in plantations (Longman 2002). The prime objective is to raise the best possible planting materials for the highest tree yield at the least possible cost in terms of capital, labour and time. Revenue from producing and selling planting materials to tree planters provides alternative farm livelihood.

Table 1 presents the criteria used to classify existing tree nurseries in northern Mindanao. The most common criterion is the area covered, which indicates the

Table 1 Types of tree nurseries in northern Mindanao^a

Type of nursery	Average area covered (m ²)	Annual seedling capacity	Function	Life of structures and facilities	Operational system	Management
Government	1,015	164,333	Reforestation projects, for distribution	Permanent	Centralised	Formal
Commercial	3,060	334,000	For sale	Permanent	Centralised	Formal
Smallholder (individual and group nurseries)	667	21,000	Community planting, planting in individual farms, for sale and gifts	Temporary to semi-permanent	Decentralised	Non-formal
Others (SCU ^b and NGO-managed)	20,000	5,180	Academic, research, tree planting, for distribution	Semi-permanent to permanent	Centralised	Formal

^a Columns 1 and 2 are limited to the data collected from the sources mentioned

^b State colleges and universities

Sources: CENRO-Initao, Misamis Oriental; CENRO Gingoog City; PENRO Malaybalay City; ICRAF; Balay Mindanaw Foundations Inc. (BMFI); Kitanglad Integrated NGOs (KIN)

capacity to produce a specific quantity of planting materials. Commercial operators have the largest seedling production nurseries. For example, the Bukidnon Forestry Inc. (BFI) nursery is situated in a 5 ha area, and has the capacity to produce 5.3 M tree seedlings a year for its 21,000 ha industrial tree plantations bounding the municipalities of Impasugong, Malitbog, Manolo Fortich and Malaybalay City (BFI 2003). Their nursery has well equipped greenhouse facilities with an overhead irrigation system, and pricking and hardening facilities. Another example is HOLCIM, a leading cement company, which maintains a huge tree nursery in Iligan City with similar objective to those of BFI.

The nursery establishment objectives influence the duration and production capacity of nurseries. Nurseries producing primarily for sale generally produce more seedlings than those designed to meet the seedling requirement of communal tree planting activities or for the members' own farms. Government nurseries mainly produce seedlings for reforestation projects and maintaining tree parks and road belting or for free distribution to landholders and communities. Most smallholder nurseries are group-managed and are project-based where seedlings are raised for use in community plantations. In some group nurseries, seedlings are raised and subsequently distributed to group members for planting on their own farms. Examples of this are the CBFM-managed and Landcare nurseries.

Government nurseries are generally permanent since tree planting is a continuous activity, particularly for DENR, DA and LGUs. State colleges and universities (SCUs) offering forestry and agroforestry courses also maintain permanent nurseries

for teaching and research purposes. Project-managed nurseries are semi-permanent or temporary. Smallholder nurseries are mostly temporary, ceasing operation as soon as planting requirements are met, although some have found opportunities for continuing their operations. Smallholder nurseries refer to nurseries operating in limited production scale, and not registered with the government's accrediting agencies. Nursery construction materials are usually round timber or bamboo poles, with coconut palms or black plastic net for shading. A small hut or kiosk is usually built alongside the nursery for farmers to gather, which also serves as venue for meetings and short training events, e.g. 2-h or 1/2 day training.

On the basis of organisational structure and management, nurseries can be formal or non-formal (Simons 1996; Koffa and Roshetko 1999). Formal nurseries are recognised, registered and have licensed business activities. This generally includes government, commercial, SCU and project-managed nurseries. These are managed by hired labour supervised by a forester or trained staff. At the barangay level, local people maintain government nurseries on a voluntary basis. Depending on availability of funds, one or two farmers are sometimes hired to oversee the nursery. In contrast, non-formal nurseries operate spontaneously among groups, households and individual farms within farming communities, without registration and with little or no external intervention.

Tree nurseries are further classified into centralised and decentralised in terms of operations (Koffa and Roshetko 1999). Centralised nursery operations—including government, private, SCU and project-managed nurseries—are maintained in a few sites to concentrate supplies, equipment and materials in strategically located areas. By contrast, decentralised nurseries areas dispersed in multiple locations in the communities and are usually managed by groups or individuals. The species of trees raised depend on the objectives of setting up the nurseries, and can be fruit, timber and industrial trees, of indigenous and exotic species. The nursery of DENR-ERDS (Environment Research and Development Section) in Malaybalay City raises various indigenous tree species for protection planting in forest reservations. The most commonly raised indigenous species are narra (*Pterocarpus indicus*), lauaan (*Shorea* spp.) and other dipterocarps. These are transplanted in the 120 DENR dipterocarps demonstration plantations in Bukidnon, Camiguin, Misamis Oriental and Misamis Occidental provinces. The DENR-ERDS nursery also provides free seedlings, but does not provide free transportation from the nursery to the planting site.

Table 2 reports the number of nurseries in Bukidnon and Misamis Oriental provinces. Smallholder nurseries have the greatest number (almost 500). These data are, however, limited to records of DENR, the World Agroforestry Centre (ICRAF), Balay Mindanaw Foundations Inc. (BMFI) and Kitanglad Integrated NGOs (KIN).

Most of these smallholder nurseries were established and managed with technical advice and material support (e.g. polyethylene bag, seeds, fertilizers, nets for shade) from NGOs and LGUs. By and large, farmers pooled their own resources to manage these nurseries. The non-formal and decentralised nurseries are said to be the major sources of planting materials in many developing countries, as in the Philippines (Koffa and Roshetko 1999; Bertomeu 2003).

Table 2 Tree nurseries in northern Mindanao, 2007

Nursery ownership type	Province		Total
	Bukidnon	Misamis Oriental	
Government—DENR, DA and LGU-operated nursery	7	8	15
Commercial nursery (large scale)	8	12	20
Individual household nursery (small scale)	31	263	294
Group nursery	80	106	186
Others (including project-managed and SCUs) nursery	2	2	4
Total	128	391	519

Sources: CENRO Initao; CENRO Gingoog City; PENROMalaybalay City; ICRAF; BMFI; KIN

Accreditation of Nurseries

DA Memorandum Circular (MC) No. 6 in 1994 (amended through MC No. 3 in 2006) tasks the Bureau of Plant Industry (BPI) through the Crop Production Division to carry out accreditation of operators and their nurseries. As of August 2007, there were 15 accredited and re-accredited plant nurseries in northern Mindanao (Bukidnon 7, Cagayan de Oro City 3, Misamis Oriental 3, Lanao del Norte 1, and Gingoog City 1), up from only seven in 2006 (DA 2007). The increase was attributed to the incentives given to nursery operators, including free technical assistance, and assistance in securing documents and clearances during transport and marketing. The databases are also used in linking nursery operators to buyers, and they are given priority in government seedlings procurement. Plant nurseries have become a lucrative business in the region, hence the number of seed and scion orchards has been increasing.

Notably, the accreditation process—under the DA Extensive Seed Production Program—only includes fruit trees, which have been identified as commercial crops together with corn, rice, legumes and vegetables. There is no accreditation for timber trees as yet. DENR 10 has a list of recognised tree nurseries in the region (timber and fruit alike) compiled mainly for the Greening Philippines Program's inventory of available seedlings.

Smallholder Nurseries: Operations, Technical Knowledge and Skills, and Marketing

Smallholder nurseries are usually individually managed with the help of family members or by groups of typically up to 10–15 households. These nurseries are dispersed in location and operate periodically depending on the owners' needs and the local market demand. This makes monitoring and exercising control over their production and distribution system challenging. In group nurseries, tasks of maintenance are assigned to members or members choose the tasks they are comfortable doing.

Germplasm Type, Source and Collection Method

It is critical for smallholders who have low capacity to absorb risks and cannot afford failure on tree farms to use high quality germplasm. In Lantapan, Bukidnon, smallholders collect and share seeds with other farmers to propagate in their nurseries. They follow a set of standards in assessing the seed quality, including cleanliness, freedom from diseases, freshness and storage condition, as well as maturity (Koffa and Roshetko 1999). For selecting mother trees, various criteria are applied, including straightness of bole and self-pruning behaviour. This shows that farmers recognise the importance of adopting collection practices to ensure high quality seedlings.

The main types of germplasm collected are seeds, seedlings and wildlings (Koffa and Roshetko 1999; Tolentino et al. 2003). Smallholders collect seeds either from the ground or by climbing the trees. However, the majority do not practice seed quality grading during seed collection. Tree seed collection actually requires specialist knowledge, and tools and equipment, which smallholders cannot afford. They also lack suitable seed storage facilities. While a few conduct germination tests to ascertain seed viability, most rely only on feedback from users.

Table 3 lists the commonly raised tree species in the smallholder nurseries in Claveria and Lantapan. These species are chosen on the basis of farmers' perceived market demand or end-use of the trees, such as timber for house construction, fodder, fuelwood and medicine. In cases where groups are facilitated by projects, species choice is mostly influenced by the recommendation of the supporting agencies. For example, most of the trees propagated in the smallholder nurseries assisted by KIN have been indigenous species for biodiversity protection and restoration. Some smallholder nurseries produce a combination of fruit and timber species, both exotic and indigenous. Since many of these farmers are trained in asexual propagation, the choice of fruit tree species is largely influenced by availability of scion groves.

Table 3 Tree species commonly raised in smallholder nurseries in Claveria and Lantapan

Species group	Common name	Scientific name
Exotic trees	Eucalyptus	<i>Eucalyptus</i> spp. (<i>E. deglupta</i> , <i>E. robusta</i> , <i>E. torelliana</i>)
	Acacia	<i>Acacia</i> spp. (<i>A. mangium</i> , <i>A. lebbekoides</i>)
	Gmelina	<i>Gmelina arborea</i>
	Mahogany	<i>Swietenia macrophylla</i>
Indigenous trees	Lauan	<i>Shorea contorta</i>
	Molave	<i>Vitex parviflora</i>
	Chestnut	<i>Anas castanea</i>
Fruit trees	Durian	<i>Durio zibethinus</i>
	Rambutan	<i>Nephelium lappaceum</i>
	Jackfruit	<i>Artocarpus heterophyllus</i>

Source: Tolentino et al. (2003)

Technical Knowledge and Skills of Nursery Operators

Many smallholder nursery operators have had attended in training on planting stock production, mostly provided by NGOs involved in upland development projects—including ICRAF, BMFI, KIN—and government agencies including the DA and DENR. Some acquired hands-on experience from being employed in forest nursery work in past reforestation projects. For instance, the ADB-funded Muleta-Manupali Watershed Development Project (MMWDP) implemented by DENR in 1980–1982 hired hundreds of local people in Valencia and Lantapan to perform many activities in the reforestation project, including tree planting and managing nurseries (Garrity et al. 2001). Many farmers also relied on personal experiences through trial-and-error experiments on their own farms. These experiences resulted to varying levels of knowledge and skills among nursery operators. In practice, many still fail to follow the standardized methods of nursery operations, and still have much to learn about seeds and seedling production processes and nursery management.

Marketing of Planting Materials

Most smallholder nurseries are established to produce seedlings for planting on farms. Only a few seriously engage in selling, particularly those frequently hosting cross visits by other farmers, NGOs, and staff of LGUs from other places. They view field visits as an opportunity to not only share technologies and their experiences but also to promote seedling sales. Sales are intended to generate income for the group to fund other livelihood activities. Sometimes, when large nurseries cannot meet their seedling orders, smallholder nurseries help fill in the gap. Hence, the extent of operations of some smallholder nurseries depends on market opportunities, and sales are strongly seasonal, usually peaking at the onset of the rainy season. One reason for the uncertain and low sales is the lack of information by potential buyers about existence of smallholder nurseries and the species available for sale.

Benefits and Constraints for Smallholder Nurseries Engaging in Marketing

Smallholders are encouraged to engage in nursery activities for the following reasons (Table 4):

Less capital required in acquiring seedlings. Smallholder nurseries are more practical to establish because only small plots of land and minimal other inputs are needed. They can raise their own planting materials and establish tree farms at lower cost.

Efficient distribution. Most smallholders live in isolated locations where planting materials cannot readily be accessed from government and private nurseries. Even if seedlings are available for free, they cannot afford the transport cost. Also, the complicated paperwork and long process of obtaining planting materials are daunting for them.

Table 4 Farmers' perceived benefits and constraints in smallholder nurseries

Nursery type	Benefits	Constraints
Individual household	Better management and maintenance	Difficult procurement of germplasm (lack of information on sources and high costs)
	Freedom to sell seedlings	Capital cost of tools and materials
	No limitation in the kinds and numbers of seedlings to grow	Lack of knowledge on site-species matching
		More accessible to stray animals
		Lack of incentives
Group	Distribution and management efficiency	Lack of proper coordination and/or participation in the management and maintenance
	Procurement of germplasm, tools and other nursery materials is easier	Sustainability after the withdrawal of supporting agencies
	Better nursery infrastructure (no access to stray animals)	Knowledge on site-species matching
	Convenient location	Capital outlay
	Sustainability of tree farming activities	Sources and supply of high quality germplasm
	Learning, exchange of ideas and dissemination	Technical knowledge in nursery management
		Low sales
		Limited access to market information
		Lack of incentives

Source: Adapted from Koffa and Garrity (2001) and Bertomeu (2003)

Species diversification. Farmers can raise a variety of preferred tree species, because they are not bound to any project dictating the species to raise. With group action in seed collection and seed exchange, they can have access to a wide species base.

Additional income. Some farmers see opportunities of earning extra income through operating nurseries. Others view this as a livelihood activity to augment their meagre farm income. They can produce seedlings opportunistically when there is a demand.

Encouragement of self-learning. Many are encouraged to apply what they have learnt from attending training courses and taking part in field trips, by operating their own nurseries. They can experiment with various propagation techniques and nursery practices without fear of failures, and would have adequate knowledge on the quality of their seedlings, because these can be tested on their own farms.

Sustained tree farming. Maintaining smallholder nurseries can be an approach to sustaining small-scale forestry and agroforestry systems because the means exists to produce planting materials whenever necessary.

Many of the smallholder nurseries wane after the operators satisfy their own planting materials. A number of factors hinder farmers from continued production, or put them at disadvantage if they engage in marketing:

Lack of capital. No matter how minimal, seedling production requires investment to set up and maintain. Storage and processing facilities for seeds and seedlings are required to produce high quality planting materials. Most smallholders do not have the capital to invest in nurseries.

Uncertainty of seedling sales. Many nurseries operate only as a farm sideline activity to limit risks because of uncertainty in sales.

Limited access to market information. Most smallholders have little access to market information concerning seeds and seedling demand and price, as well as weak linkages with potential large-scale buyers. Hence, they have little knowledge to judge the quantity of seedlings to produce, and how and where to market them.

Sub-standard quality of seedlings. Small-scale nursery operators have little knowledge of market specifications for seedlings or the species the markets want. Often, they raise the same tree species grown by their neighbours. The seedlings produced do not meet market quality expectations, which makes nursery operators ineffective in dealing with buyers with whom they must negotiate prices.

Lack of incentives. These nurseries were established with limited external support. Provision of new nursery technologies, market networks, or simple materials from the government usually do not reach them.

Unfair competition. There are cases when government competes with smallholders to supply planting materials. This is a case of the experienced government versus the inexperienced nursery operators. Also, buyers prefer the commercial nursery operators planting materials over those of smallholder nurseries because of the superior quality and ready availability, in the desired quantities. To obtain large quantities of seedlings, many smallholders have to be contacted and consolidated, which makes transaction costs higher, and hence less attractive.

Lack of marketing capabilities. Smallholders are generally reserved and timid due to their limited interactions with people and agencies outside their communities and limited opportunities for participation in economic activities other than farming. Engaging in nursery enterprises requires basic knowledge on marketing, appropriate attitudes, confidence and skills.

Accreditation. Among the many required documents and criteria to meet to become an accredited nursery, it is difficult for smallholder nurseries to achieve the scale of operation that can justify being accredited.

Building Elements to Sustain Smallholder Nurseries: The ICRAF Experience

For more than 10 years, ICRAF has been working with upland farmers in developing small-scale tree farms and agroforestry systems, particularly in fostering smallholder nursery activities. There are lessons that can be learnt from these experiences—both successful and unsuccessful ones. Partnerships, equal market opportunities and policy support are the external factors that can create an enabling environment. Understanding how these elements interact and can be made available for smallholders can be useful to enhance their potential and sustain their operations.

Making Nursery Technologies Available and Improving Quality Seedlings

Survey results reveal that smallholders already have the basic knowledge and skills to produce planting materials (Koffa and Roshetko 1999; Tolentino et al. 2003).

Generally, nursery operators focus on quantity and diversity of species (producing seedlings of timber trees, fruit trees, ornamentals and medicinals), rather than quality, in order to sustain their operations. In some nurseries, seedlings are etiolated, forked and branchy, which reflects poor nursery management. Seedlings of some tree species, particularly the exotics, are sold in Cagayan de Oro City at less than a quarter of the price elsewhere in the Philippines, e.g. in Leyte province. If nursery management is improved, the seedling price may be doubled or tripled. The large tree planters refrain from buying these roadside displays because of uncertainty about seed sources.

There are other equally important technical issues for improving seedling quality, such as availability of high quality seed, adequacy of seed supply, and information on the origin of the seeds. Clonal propagation may be promoted for efficient production of high quality planting materials of some species which are difficult to propagate by seed. There is a need for these technologies for fruit trees, tree vegetables and medicinal trees to enhance diversification.

In the context of agroforestry, latex-timber and fruit-timber systems can also be a technical option. With sound tree management, farmers can grow rubber trees, which will produce latex after 5–6 years, and timber after 40–45 years of tapping. Fruit trees—e.g. durian, jackfruit and marang (*Artocarpus odorisimus*)—can produce fruit during the early years, and timber in later years. Timber from fruit trees is highly valued for furniture and house construction. Promoting various tree farming systems would create demand for smallholder nurseries.

Mobilising Smallholder Nurseries and Meeting Market Demand

Most individual and household nurseries are affiliated with group organizations, which have been either direct beneficiaries or active partners of government or private sector forestry-related programs (Pulhin et al. 2006). In fact, some of these group nurseries have become important sources of planting materials for various tree-farming projects. ICRAF's experience with institution building is drawn from facilitating the growing Landcare groups activities in the southern Philippines.

In 1996, a Landcare movement of farmer-led knowledge-sharing organizations evolved in Claveria, Misamis Oriental. This Landcare movement was interested in learning and sharing experiences with new technologies that increase income while conserving natural resources (Mercado and Garrity 2000). The initial objective of the Landcare movement was to diffuse conservation farming technology based on natural vegetative filter strips (NVS) and agroforestry practices among upland farming neighbourhoods, but the movement later expanded to include many aspects of community action, such as information-drive campaign, riparian rehabilitation, water quality monitoring, livelihood and resource mobilization. Seedling production was one of its main household and communal activities.

Seedling production was largely associated to the Landcare organisational structure (illustrated in Fig. 1). Typically, 10–15 households form themselves at the sitio-level into self-governing groups with a set of officers. These small groups are linked with a broader network of associations at barangay, municipal and provincial

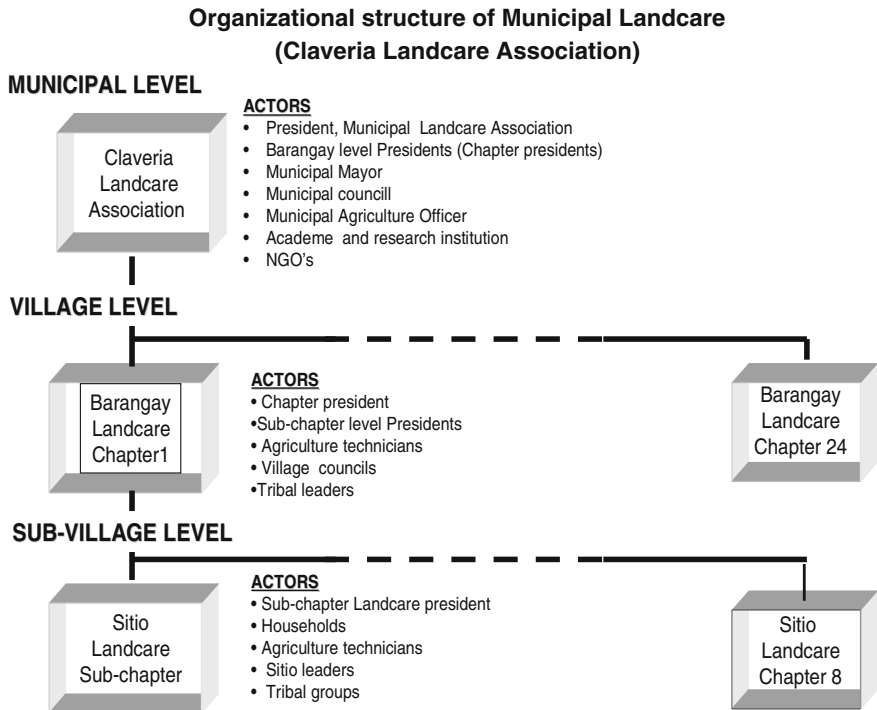


Fig. 1 Organization structure of Landcare at municipal level. *Note:* Chapters and sub-chapters refer to hierarchical groups within the Landcare organization

levels, in the form of federations, creating a strong flow of information horizontally (farmer-to-farmer) at each level, as well as vertically (from sitio to provincial level and vice versa). This structure also enhances dialogue from farmers to politicians, technicians, academes and other service providers. Seedling production under the Landcare program is carried out at the barangay, sitio and household level. The communal nurseries at the barangay and sitio level are typically used for training and knowledge-sharing activities. The bulk of seedlings are produced at the household level.

The Landcare activities created dramatic increase in human and social capital, particularly peer pressures among different sectors, which resulted in an exponential rate of adoption of sustainable farming practices, e.g. agroforestry and tree farming. As of 2003, 3,000 households in Claveria alone were members of the 145 chapters of the Claveria Landcare Association (CLCA) (Mercado and Cadisch 2004). They have initiated 300 tree nurseries, for both fruit and timber trees. While the majority of these have been established to produce planting materials for their own use, a few have been engaged in selling seedlings. The Landcare activities are also active in Lantapan, Bukidnon and 15 other municipalities in five provinces in the Visayas and Mindanao.

Overall, this community-based organization has contributed to the spread of knowledge and skills on nursery operations. The effect of this is clearly evident in

the rapid increase in tree planting on farms, and thus with the planting materials raised. If the objective is to achieve a rapid increase in the number of seedlings raised, this institutional arrangement of smallholder nurseries can be an effective strategy. By working together, smallholders can gain marketing prowess with buyers. Group nurseries usually are not sustainable, but have provided farmers with an opportunity to learn about desirable nursery practices, which can be applied at their respective household nurseries.

The Role of Governments and Service Providers in Building Partnerships

Partnership building refers to a deliberate effort of linking partner institutions and other stakeholders that can provide mutually sustainable support to local nurseries operated by farmer groups or private individuals. The large number of smallholder nurseries in northern Mindanao can be attributed to the donor agencies, local governments and extension workers and facilitators in forestry and agroforestry development who have been working with farmers to promote the establishment and management of smallholder nurseries. The relevant stakeholder groups are reported in Table 5.

These agencies all promote tree farming to improve land productivity and protect the environment. DENR's inability to provide planting materials to a large number of smallholders led to the involvement of the private sector and NGOs and assisted the smallholders to produce their own planting materials through smaller nurseries. Similarly, the availability of incentives and financial assistance from the various institutions boosted the establishment of smallholder nurseries, where training and simple planting materials are provided. However, there are also instances where competition exists between these actors, particularly in producing seedlings for financial returns. Instead of competing with local nurseries in producing planting materials, the government can play a more useful role in providing financial, technical, policy and other administrative support (e.g. seed bank or storage) in order that these local operators produce high quality seeds and seedlings at reasonable cost.

Beginning in 1999, instead of continually operating an inefficient central nursery, the Local Government of Claveria, Misamis Oriental, provided PhP 50,000 every year per barangay for nursery-related activities. Subsequently, each barangay established sitio nurseries. Each barangay has 8–12 sitios, hence the program resulted in hundreds of group and household nurseries being established (Mercado and Garrity 2000), instead of having just one municipal central nursery. More seedlings were produced and seedlings were more accessible to farmers, particularly those in remote locations. This addressed the problem of seedling distribution from centralised government nurseries, which arose because most of these government centralized nurseries are not accessible to small farmers in remote villages.

Marketing Opportunities for Smallholder Nurseries

Region 10 has a timber deficit and growing demand. In 2003, the annual log requirement of regular sawmill, mini-sawmill and plywood plants was 528,575 m³,

Table 5 Key actors in smallholder nurseries and their roles

Key actor	Major roles in smallholder nurseries
Smallholders (individual farmer or group of farmers)	Maintain nurseries planting on own farms and the local market Implement seedling production contracts for reforestation projects Implement contracts on planting and maintenance of reforestation projects
DENR	Implement forest rehabilitation initiatives, where smallholders may participate Promote and enforce science-based policies and practices, with implications to smallholder nurseries Provide technical assistance, and incentives (e.g. free planting materials) Provide capacity-building (e.g. training)
DA	Promote science-based policies and practices, with implications to smallholder nurseries Provide technical assistance, and incentives (e.g. planting materials) Provide capacity-building (e.g. training)
LGUs	Enforce forestry laws and implement reforestation and related forestry projects in partnership with the DENR and local communities Pass provincial, municipal and barangay resolutions appropriating funds to continue ISF, finance CBFM and other reforestation projects Provide incentives to smallholder nurseries (technical and financial support)
Other government agencies (e.g. NIA, NPC, Local Water Districts)	Implement reforestation activities in watersheds under their jurisdictions
The academe and other research institutions	Promote science-based policies and programs Provide technical assistance to farmer groups Provide capacity-building to farmer groups Project monitoring and evaluation (M&E)
NGOs	Advocate policy reforms Provide technical support to people's organizations, including smallholder nurseries Provide financial support to people's organizations, including smallholder nurseries Implement government reforestation programs Participatory monitoring and evaluation (PM&E)
Funding institutions (international and local)	Influence international and national reforestation policies and programs Provide technical support Provide funding support

while log production was only 35,166 m³, with existing sawmill plants operating well below their capacity. This large deficit does not include shortages of other wood products such as pulp and paper, furniture, matchsticks and novelty items.

Nevertheless, 135 mini-sawmills were supplied with logs of *Gmelina arborea* and *Paraserianthes falcataria*, mostly grown by smallholder farmers (Bertomeu 2003). Other species milled in smaller volumes include *Acacia mangium*, *Swietenia macrophylla*, *Eucalyptus deglupta* and *Spathodea campanulata*. Growing trees on farms is still considered a viable livelihood alternative and an activity with an importance to the wood industry. Smallholder nurseries have the opportunity to continue operating to meet seedling demands for tree farming.

The Revised Master Plan for Forestry Development (2003) projected a deficit of more than 22 M m³ of logs by 2010. To address this, forest rehabilitation has been identified in the General Program of Actions (2005–2010) recently drafted by the DENR. In 2005, the Arroyo administration initiated the Green Philippine Program, which aims to plant 20 M trees across the country. The regional offices of DENR are tasked to mobilise local resources to plant portions of this. Region 10 aims to plant 2.41 M trees in 531 ha (Table 6). Planting activities have been integrated in various programs, including protected areas restoration, watershed rehabilitation, agroforestry development through CBFM, plantation establishment, roadside greening and urban forestry, and mangrove planting.

The Green Philippine Program would have been an opportunity for smallholder nurseries to participate, and generate revenue at the same time. However, most of the seedling sources identified by DENR were from government, commercial and university nurseries, with only a small seedling quantity from smallholder and people's organization (PO) nurseries. On the other hand, the DA is currently implementing an agroforestry program under its Sustainable Agriculture Development Program for the Uplands in partnership with the private sectors, NGOs and farmer groups [Administrative Order (AO) No. 29/2007]. A major requirement of this program is the planting of horticultural tree crops which include fruit and rubber trees together with high-valued agricultural crops.

Given these opportunities, more efforts may focus on enhancing quality of seedlings production and thus ensuring markets. Market analysis may be conducted to identify the tree species for which opportunities exist. This is the best way to ensure that seedlings produced will have positive impacts on smallholder's livelihoods. Further, an analysis of the supply chain would be desirable to understand the various stages of production and marketing, to ensure efficiency and

Table 6 Sources and seedlings of various species for Region 10 Philippine Greening Program

Source	No. of seedlings	Species	No. of seedlings
DENR 10 counterpart fund	706,467	Forest trees	2,325,827
Available seedling stock at DENR 10 nurseries	158,034	Fruit trees	42,867
Commercial, wood-based industries, NGOs, and academes	1,549,723	High-value species	38,849
		Ornamental flowering trees	6,681
Total	2,414,224		2,414,224

Source: DENR 10 inventory

profitability. The experience with Landcare and ATSAL are useful frameworks to commence this initiative.

Institutionalising Accreditation and Incentives

Little legislation related to seedling production exists in the Philippines, most of this being sections of major tree farming laws and policies. For example, *Republic Act (RA) 7607* known as the *Magna Carta for Small Farmers*, notes ‘the need of farmers for quality seeds and planting materials’. RA 7308 otherwise known as the *National Seed Industry Development Act 1992* mandates the National Seed Industry Council to ‘promote among persons, groups, cooperatives, and corporations for genetic resources conservation, and grant incentives and other forms of assistance to seed or plant breeders’. At the local level, these policies and the associated incentives are seldom diffused, especially to the smallholders. This Act further mandates BPI to supervise, coordinate and monitor production, purification and maintenance of breeder and foundation seeds of all recommended varieties and cultivars, and accreditation of seed growers and plant nursery operators. Seedling production generally forms part of tree farming activities, not a separate entity requiring specific legislation, incentives and other policy support.

DA Administrative Order No. 06 in 2006 tasks its regional field units (RFUs), BPI centres, SCUs, private growers and producers (PG/Ps) and other stakeholders to produce high quality seeds and planting materials, establish scion groves, and produce forest reproductive materials particularly in those areas which cannot be reached by accredited private and public seed growers and nursery operators. This Order also mandates private and public seed growers, seed companies and plant nursery operators to accredit their operations as well as to produce high quality seeds and seedlings, and encourages them to discover, develop and propagate excellent indigenous materials for commercial production and distribution, as well as to import outstanding quality seeds and other planting materials for experimental and breeding purposes. This order also accords seed growers and nursery operators with incentives and privileges prescribed in the Tariff and Customs Code of the Philippines.

The Role of Wood Processors in the Tree Seedling Production System

Large wood processors in Mindanao are committed to ensuring that seedlings planted by the farmers are of high quality. It is in their interest to ensure that trees planted will produce high quality timber at reasonable prices, because these processors are the ones who will buy the trees later, and sell the timber products. The industry would also like to ensure a sustainable supply of timber given the current selective logging ban in vital areas including watersheds, biodiversity reserves and protected areas. These wood processors are looking at smallholders as the main producers of raw timber to fill the gap of dwindling supply coming from natural forests and imports from foreign countries, which are now regulating their sales of raw logs. In this context, wood processors can be considered as the

accrediting agency, rather than the traditional DENR or LGUs. This is to avoid exploitation of power by unscrupulous public officials citing various laws and regulations, which are prevalent in transporting tree products, and through which they may require 'fees' to issue or process permits and clearances which often have no legal basis. Proper accreditation of nursery operators should not only ensure that farmers produce high quality seeds and seedlings, but also that fair opportunities exist for them to participate actively in the industry free from unwarranted charges. In this way, both the supplier (smallholder nurseries) and the market (seed and seedling buyers) will be protected.

Any extension program relating to seedling production requires farmer empowerment not only in terms of technical, institutional and marketing assistance but also in terms of government legislation and incentives. Development of legislation and incentives on seedling production is required. Ideally, smallholder nurseries should be represented in the industry, and should have strong linkages with forest industries and processors, and the government should be the one to lead in facilitating these processes.

Conclusion

Many smallholders in northern Mindanao have been engaged in seedling production, for farm needs and local markets. Experience indicates that smallholder interest in sustaining seedling production depends on market demand and incentives, which translate to financial benefit from sound nursery practices and reliable access to profitable markets. The challenge for the research, academe, extension and government agencies is to help facilitate the development of such an enabling environment. Activities that will assist smallholder nurseries to achieve their full potential as producers of a sufficient quantity of seedlings of high quality, and sustain these activities, include:

- (1) Making available nursery technologies to produce high quality planting materials;
- (2) Building farmer groups to facilitate seedling production and product marketing and enhance the scale of marketing;
- (3) Building partnerships with various service providers to address technical, institutional, marketing and policy issues that may hamper smallholder nurseries;
- (4) Ensuring access to markets and market information;
- (5) Advertising of seedling nursery businesses, along with their locations, species raised and corresponding prices.
- (6) Providing incentives and policy support.

The benefits of building a small-scale seedling production system are not limited to the smallholders. Benefits also accrue to the government, wood processors and to the general public. These benefits include an assured supply of planting materials for reforestation and tree plantation endeavours, increased timber supplies to meet local and international needs, strengthened smallholder livelihoods as well as local

and national economies, diversified landscapes and the protection of environmental services derived from planted trees.

There is still a lack of information about the extent of small-scale seedling production and its impact on local and national timber markets, present and potential, in Region 10. Research is needed to assess: (1) the number of smallholders still actually involved in nursery seedling production activities; (2) household income provided by seedling production (as both total and proportion of household income); and (3) the volume and value of planting materials sourced from smallholders, as a proportion to the whole seedling industry supply, by species type.

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